查询HT7022A供应商

HOLTEK

# HT70XX
# Voltage Detector

## Features

- Low power consumption
- Low temperature coefficient
- Built-in high-stability reference source
- Built-in hysteresis characteristic
- TO-92 & SOT-89 package

## Applications

- Battery checkers
- Level selectors
- Power failure detectors
- Microcomputer reset
- Battery memory backup
- Non-volatile RAM signal storage protectors

## General Description

The HT70XX series is a set of three-terminal low power voltage detectors implemented in CMOS technology. Each voltage detector in the series detects a particular fixed voltage ranging from 2.2V to 7V. The voltage detectors consist of a high-precision and low power consumption standard voltage source, a comparator, hysteresis circuit, and an output driver. CMOS technology ensures low power consumption.

Although designed primarily as fixed voltage detectors, these devices can be used with external components to detect user specified threshold voltages (NMOS open drain type only).

## Selection Table

| Part No. | Detectable Voltage | Hysteresis Width | Tolerance |
|---|---|---|---|
| HT7022A | 2.2V | 0.11V | ±5% |
| HT7024A | 2.4V | 0.12V | ±5% |
| HT7027A | 2.7V | 0.135V | ±5% |
| HT7033A | 3.3V | 0.165V | ±5% |
| HT7039A | 3.9V | 0.195V | ±5% |
| HT7044A | 4.4V | 0.22V | ±5% |
| HT7050A | 5.0V | 0.25V | ±5% |
| HT7070A | 7.0V | 0.35V | ±5% |

Note: The output type selection codes are:

NMOS open drain normal open, active low

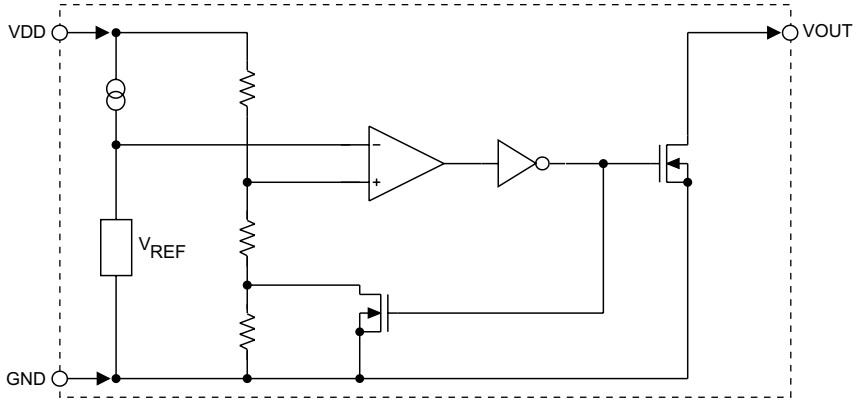
For example: The HT7070A is a 7.0V, NMOS open drain active low output

**Output type selection table**

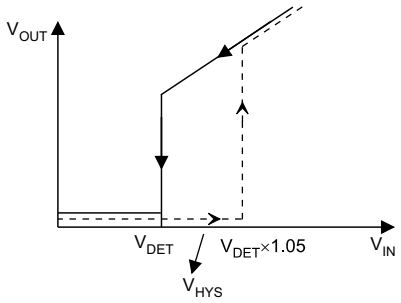
| Type \ $V_{OUT}$ \ $V_{DD}$ | $V_{DD}>V_{DET}(+)$ | $V_{DD}\leq V_{DET}(-)$ |
|---|---|---|
| A | Hi-Z | VSS |

## Block Diagram

**N channel open drain output (normal open; active low)**

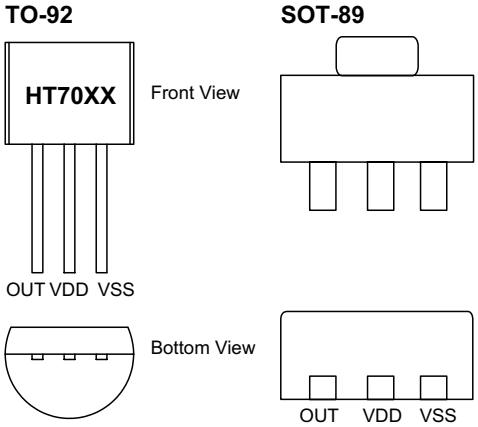



**A type**



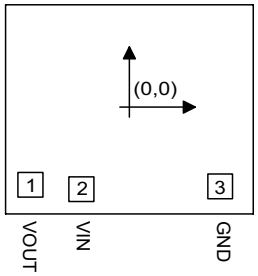

Dash line ... $V_{IN}$ from $L_O \rightarrow H_I$
Solid line ... $V_{IN}$ from $H_I \rightarrow L_O$

## Pin Assignment



## Pad Assignment

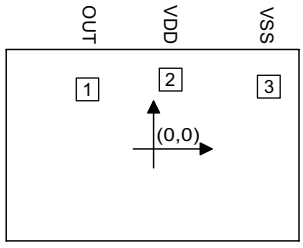
**HT70XX (except HT7022A)**




Chip size: 1317 × 1158 (μm)$^2$

* The IC substrate should be connected to VDD in the PCB layout artwork.

**HT7022A only**




Chip size: 2032 × 1321 (μm)$^2$

* The IC substrate should be connected to VDD in the PCB layout artwork.

## Pad Coordinates

**HT70XX (except HT7022A)** Unit: μm

| Pad No. | X | Y |
|---|---|---|
| 1 | –483.30 | –379.50 |
| 2 | –234.60 | –399.50 |
| 3 | 443.90 | –386.00 |

**HT7022A only** Unit: μm

| Pad No. | X | Y |
|---|---|---|
| 1 | –434.34 | 394.97 |
| 2 | 120.65 | 461.01 |
| 3 | 774.70 | 412.75 |

## Absolute Maximum Ratings

Supply Voltage, except HT7022A ..... $V_{SS}$–0.3V to $V_{SS}$+26V

Supply Voltage, HT7022A only ..... –0.3V to 13V

Output Voltage ..... $V_{SS}$–0.3V to $V_{DD}$+0.3V

Storage Temperature ..... –50°C to 125°C

Operating Temperature ..... 0°C to 70°C

Output Current ..... 50mA

Power Consumption ..... 200mW

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## Electrical Characteristics

**HT7022A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 2.09 | 2.2 | 2.31 | V |
| | Lo→Hi Detectable Voltage | — | — | 2.132 | 2.31 | 2.541 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 3.2V | No load | — | 1.8 | 4 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 1.6 | — | 12 | V |
| $I_{OL}$ | Output Sink Current | 2V | $V_{OUT}$=0.2V | 0.5 | 1 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7024A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 2.28 | 2.4 | 2.52 | V |
| | Lo→Hi Detectable Voltage | — | — | 2.325 | 2.52 | 2.772 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 1.5 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 2V | $V_{OUT}$=0.2V | 0.5 | 1 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7027A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 2.565 | 2.7 | 2.835 | V |
| | Lo→Hi Detectable Voltage | — | — | 2.616 | 2.835 | 3.118 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 1.5 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 2V | $V_{OUT}$=0.2V | 0.5 | 1 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7033A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 3.135 | 3.3 | 3.465 | V |
| | Lo→Hi Detectable Voltage | — | — | 3.197 | 3.465 | 3.811 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 1.5 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 2.5V | $V_{OUT}$=0.25V | 1.2 | 2.5 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7039A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 3.705 | 3.9 | 4.095 | V |
| | Lo→Hi Detectable Voltage | — | — | 3.779 | 4.095 | 4.504 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 1.5 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 2.5V | $V_{OUT}$=0.25V | 1.2 | 2.5 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7044A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 4.18 | 4.4 | 4.62 | V |
| | Lo→Hi Detectable Voltage | — | — | 4.263 | 4.62 | 5.082 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 1.5 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 3.6V | $V_{OUT}$=0.36V | 3 | 6 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7050A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 4.75 | 5 | 5.25 | V |
| | Lo→Hi Detectable Voltage | — | — | 4.845 | 5.25 | 5.775 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 2.1 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 3.6V | $V_{OUT}$=0.36V | 3 | 6 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

**HT7070A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DET}$ | Hi→Lo Detectable Voltage | — | — | 6.65 | 7 | 7.35 | V |
| | Lo→Hi Detectable Voltage | — | — | 6.783 | 7.35 | 8.085 | V |
| $V_{HYS}$ | Hysteresis Width | — | — | 0.02 $V_{DET}$ | 0.05 $V_{DET}$ | 0.1 $V_{DET}$ | V |
| $I_{DD}$ | Operating Current | 8V | No load | — | 4 | 7 | μA |
| $V_{DD}$ | Operating Voltage | — | — | 2.1 | — | 24 | V |
| $I_{OL}$ | Output Sink Current | 5V | $V_{OUT}$=0.5V | 5 | 10 | — | mA |
| $\frac{\Delta V_{DET}}{\Delta T_a}$ | Temperature Coefficient | — | 0°C<Ta<70°C | — | ±0.9 | — | mV/°C |

## Functional Description

The HT70XX series is a set of voltage detectors equipped with a high stability voltage reference which is connected to the negative input of a comparator— denoted as $V_{REF}$ in the following figure for NMOS output voltage detector.

When the voltage drop to the positive input of the comparator (i,e,$V_B$) is higher than $V_{REF}$, VOUT goes high, M1 turns off, and $V_B$ is expressed as $V_{BH}=V_{DD} \times (R_B+R_C) / (R_A+R_B+R_C)$. If $V_{DD}$ is decreased so that $V_B$ falls to a value less than $V_{REF}$, the comparator output inverts from high to low, $V_{OUT}$ goes low, $V_C$ is high, M1 turns on, RC is bypassed, and $V_B$ becomes: $V_{BL}=V_{DD} \times R_B / (R_A+R_B)$, which is less than $V_{BH}$. By so doing, the comparator output will stay low to prevent the circuit from oscillating when $V_B \approx V_{REF}$.

If $V_{DD}$ falls below the minimum operating voltage, the output becomes undefined. When VDD goes from low to $V_{DD} \times R_B / (R_A+R_B) > V_{REF}$, the comparator output and $V_{OUT}$ goes high.

The detectable voltage is defined as:

$$V_{DET}(-) = \frac{R_A + R_B + R_C}{R_B + R_C} \times V_{REF}$$

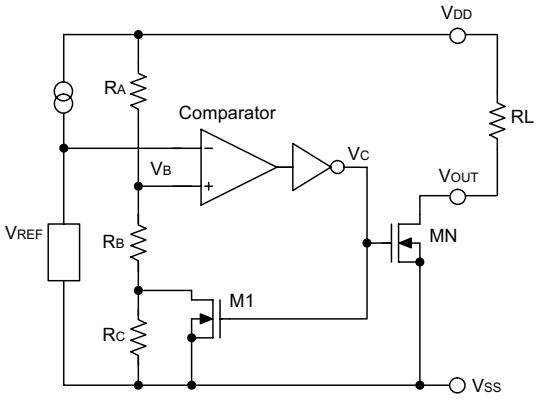
The release voltage is defined as:

$$V_{DET}(+) = \frac{R_A + R_B}{R_B} \times V_{REF}$$

The hysteresis width is:

$V_{HYS} = V_{DET}(+) - V_{DET}(-)$

The figure demonstrates the NMOS output type with positive output polarity ($V_{OUT}$ is normally open, active low). The HT70XX series also supplies options for other output types with active high outputs. Application circuits shown are examples of positive output polarity (normally open, active low) unless otherwise specified.



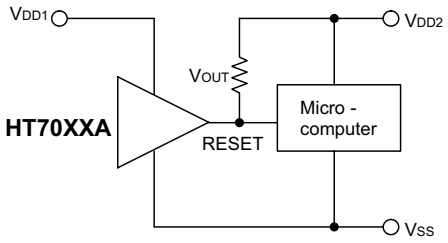

NMOS output voltage detector (HT70XXA)

## Application Circuits

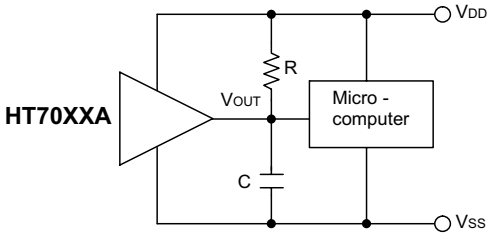
**Microcomputer reset circuit**

Normally a reset circuit is required to protect the microcomputer system from malfunctions due to power line interruptions. The following examples show how different output configurations perform a reset function in various systems.

- NMOS open drain output application for separate power supply

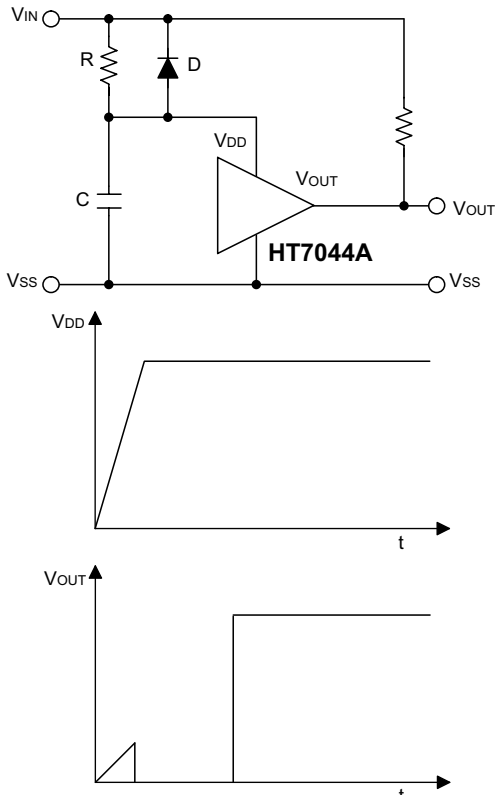



- NMOS open drain output application with R-C delay




**Power-on reset circuit**

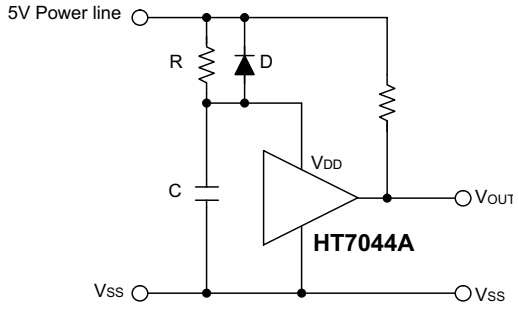
With several external components, the NMOS open drain type of the HT70XX series can be used to perform a power-on reset function as shown:



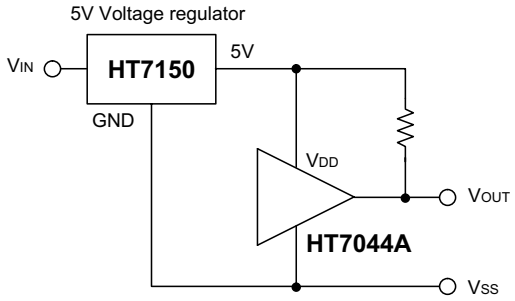
**5V power line monitoring circuit**

Generally, a minimum operating voltage of 4.5V is guaranteed in a 5V power line system. The HT7044A is recommended for use as 5V power line monitoring circuit.

- 5V power line monitor with power-on reset



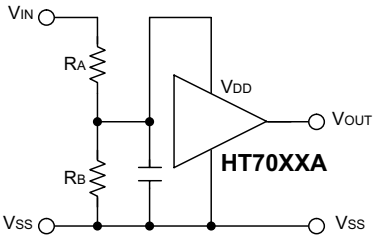

- with 5V voltage regulator




**Change of detectable voltage**

If the required voltage is not found in the standard product selection table, it is possible to change it by using external resistance dividers or diodes.

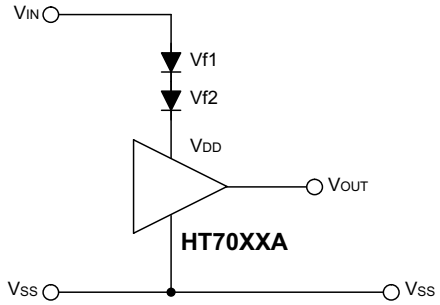
- Varying the detectable voltage with a resistance divider




$$\text{Detectable voltage} = \frac{R_A + R_B}{R_B} \times V_{DET}$$

$$\text{Hysteresis width} = \frac{R_A + R_B}{R_B} \times V_{HYS}$$

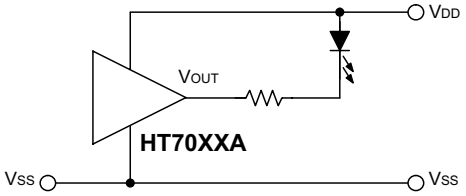
- Varying the detectable voltage with a diode




Detectable Voltage $= V_{f1}+V_{f2}+V_{DET}$

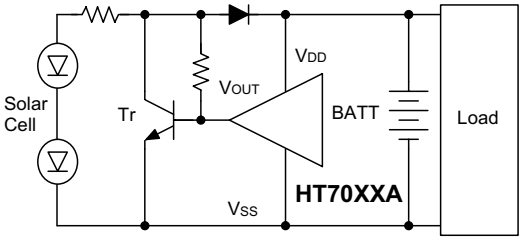
**Malfunction analysis**

The following circuit demonstrates the way a circuit analyzes malfunctions by monitoring the variation or spike noise of power supply voltage.



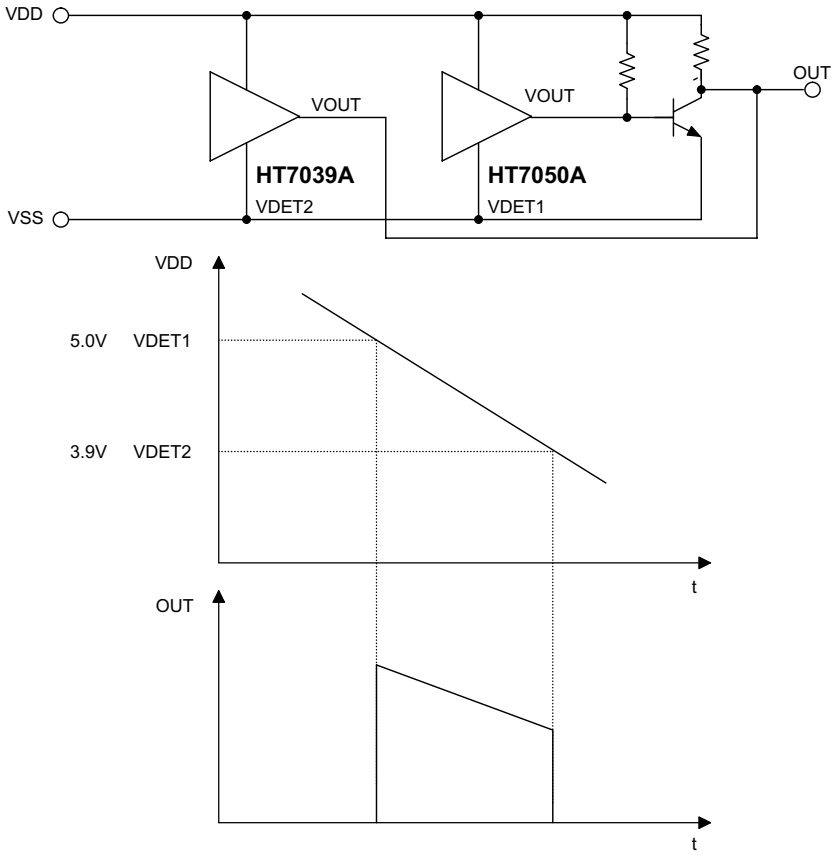

**Charge monitoring circuit**

The following circuit shows a charged monitor for protection against battery deterioration by overcharging. When the voltage of the battery is higher than the set detectable voltage, the transistor turns on to bypass the charge current, protecting the battery from overcharging.



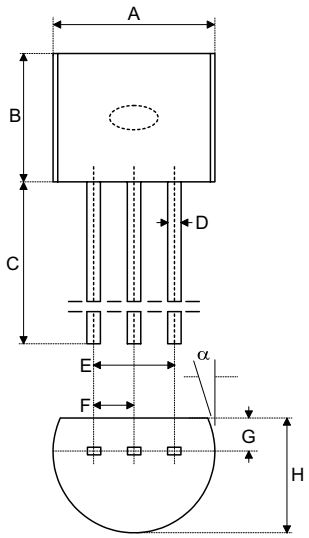
**Level selector**

The following diagram illustrates a logic level selector.



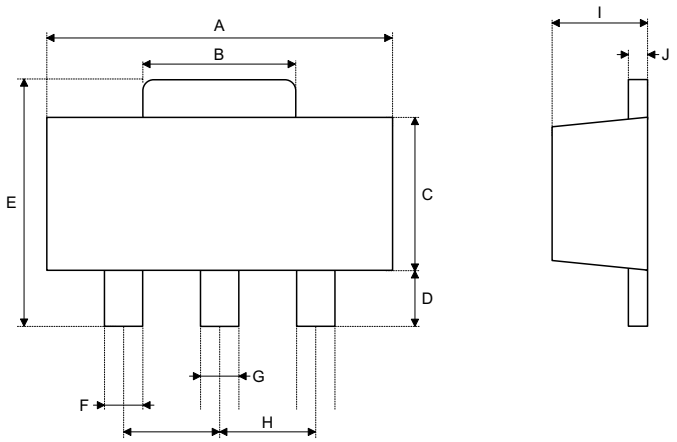
## Package Information

**3-pin TO-92 outline dimensions**




| Symbol | Dimensions in mil | | |
|---|---|---|---|
| | Min. | Nom. | Max. |
| A | 170 | — | 200 |
| B | 170 | — | 200 |
| C | 500 | — | — |
| D | 11 | — | 20 |
| E | 90 | — | 110 |
| F | 45 | — | 55 |
| G | 45 | — | 65 |
| H | 130 | — | 160 |
| I | 8 | — | 18 |
| α | 4° | — | 6° |

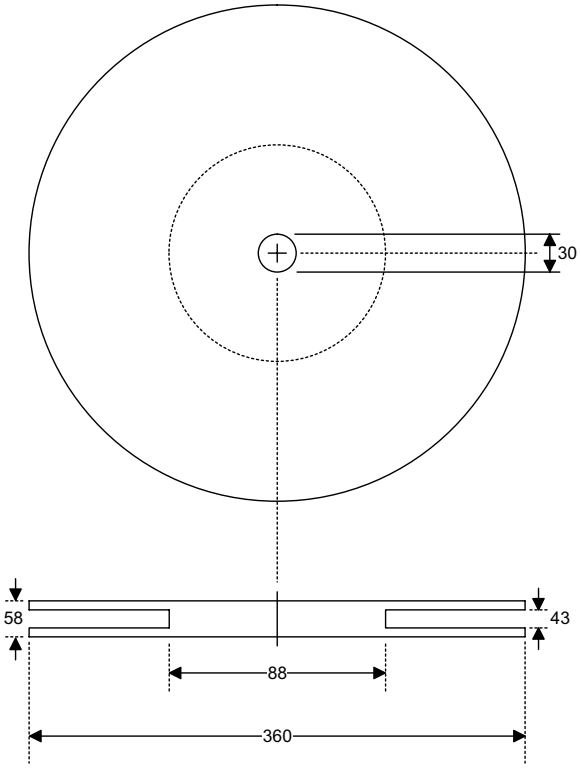
**3-pin SOT-89 outline dimensions**

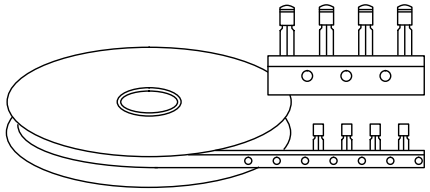



| Symbol | Dimensions in mil | | |
|---|---|---|---|
| | Min. | Nom. | Max. |
| A | 173 | — | 181 |
| B | 64 | — | 72 |
| C | 90 | — | 102 |
| D | 35 | — | 47 |
| E | 155 | — | 167 |
| F | 14 | — | 19 |
| G | 17 | — | 22 |
| H | — | 59 | — |
| I | 55 | — | 63 |
| J | 14 | — | 17 |

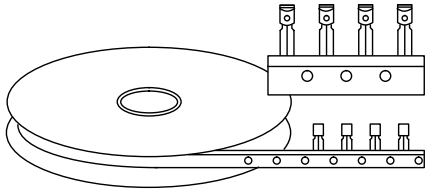
## Product Tape and Reel Specifications

**TO-92 reel dimensions (Unit: mm)**



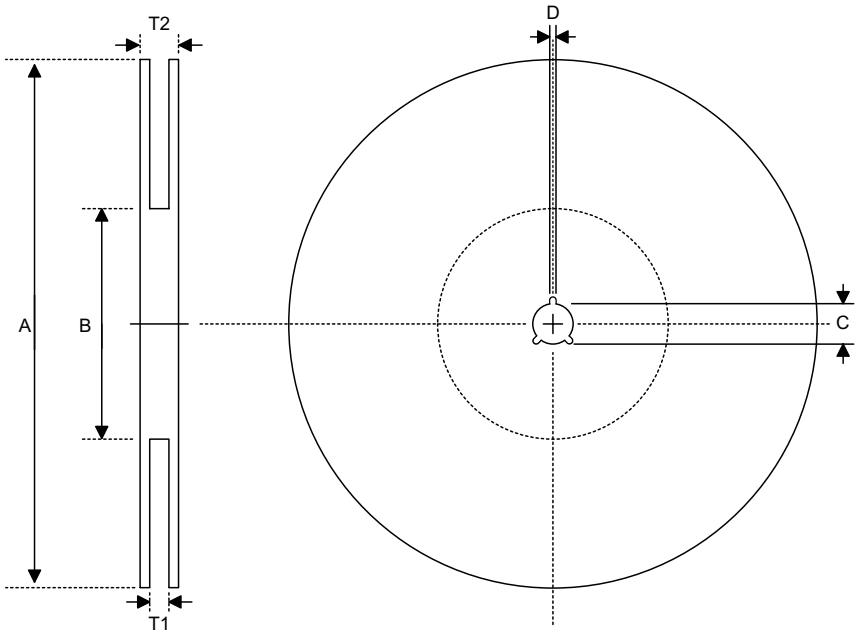



Package Up, Flat Side Up



Package Up, Flat Side Down

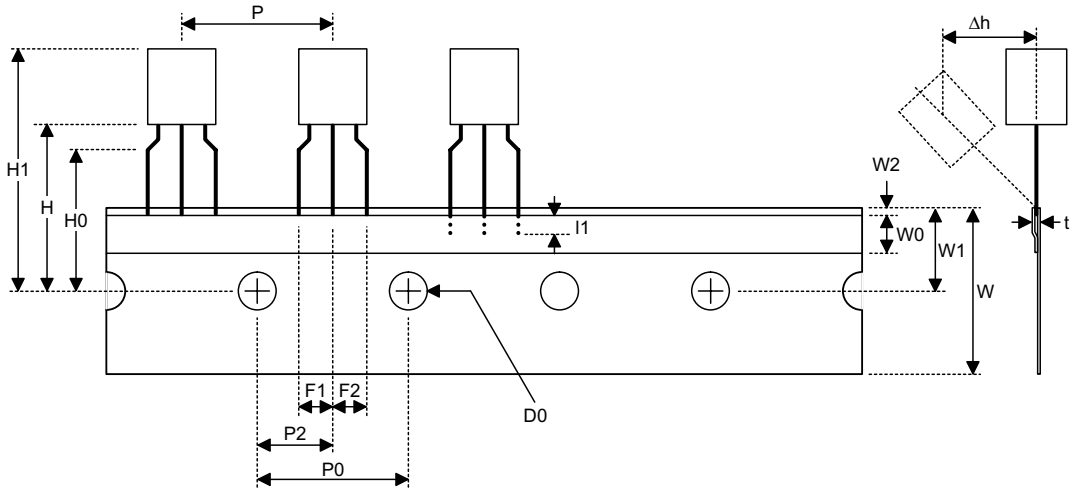
**SOT-89 reel dimensions**




SOT-89

| Symbol | Description | Dimensions in mm |
|---|---|---|
| A | Reel Outer Diameter | 180±1.0 |
| B | Reel Inner Diameter | 62±1.5 |
| C | Spindle Hole Diameter | 12.75+0.15 |
| D | Key Slit Width | 1.9±0.15 |
| T1 | Space Between Flange | 12.4+0.2 |
| T2 | Reel Thickness | 17−0.4 |

**TO-92 carrier tape dimensions**




TO-92

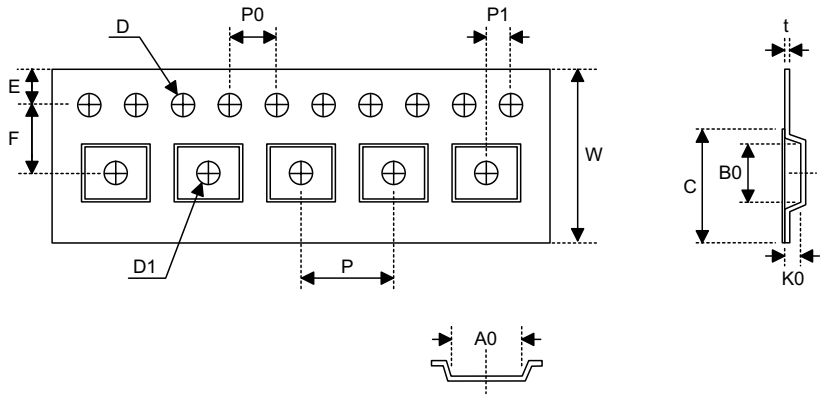
| Symbol | Description | Dimensions in mm |
|---|---|---|
| I1 | Taped Lead Length | (2.5) |
| P | Component Pitch | 12.7±1.0 |
| $P_0$ | Perforation Pitch | 12.7±0.3 |
| $P_2$ | Component to Perforation (Length Direction) | 6.35±0.4 |
| $F_1$ | Lead Spread | 2.5+0.4 −0.1 |
| $F_2$ | Lead Spread | 2.5+0.4 −0.1 |
| Δh | Component Alignment | 0±0.1 |
| W | Carrier Tape Width | 18.0+1.0 −0.5 |
| $W_0$ | Hold-down Tape Width | 6.0±0.5 |
| $W_1$ | Perforation Position | 9.0±0.5 |
| $W_2$ | Hold-down Tape Position | (0.5) |
| $H_0$ | Lead Clinch Height | 16.0±0.5 |
| $H_1$ | Component Height | Less than 24.7 |
| $D_0$ | Perforation Diameter | 4.0±0.2 |
| t | Taped Lead Thickness | 0.7±0.2 |
| H | Component Base Height | 19.0±0.5 |

Note: Thickness less than 0.38±0.05mm~0.5mm

P0 Accumulated pitch tolerance: ±1mm/20pitches.

( ) Bracketed figures are for consultation only

**SOT-89 carrier tape dimensions**




SOT-89

| Symbol | Description | Dimensions in mm |
|---|---|---|
| W | Carrier Tape Width | 12.0+0.3 −0.1 |
| P | Cavity Pitch | 8.0±0.1 |
| E | Perforation Position | 1.75±0.1 |
| F | Cavity to Perforation (Width Direction) | 5.5±0.05 |
| D | Perforation Diameter | 1.5+0.1 |
| D1 | Cavity Hole Diameter | 1.5+0.1 |
| P0 | Perforation Pitch | 4.0±0.1 |
| P1 | Cavity to Perforation (Length Direction) | 2.0±0.10 |
| A0 | Cavity Length | 4.8±0.1 |
| B0 | Cavity Width | 4.5±0.1 |
| K0 | Cavity Depth | 1.8±0.1 |
| t | Carrier Tape Thickness | 0.30±0.013 |
| C | Cover Tape Width | 9.3 |

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